

## CLAIMS

We claim:

1. A method of manipulating a voxel object, comprising the steps of:  
selecting a voxel grid comprising a plurality of voxels;  
representing a 3D object in a first voxel space representation comprising at least a portion of said plurality of voxels, and  
converting said first representation into a second voxel space representation, said second representation defined by a plurality of boundary voxels representing a border of said 3D object, wherein said second representation is exclusive of outer voxels, said outer voxels disposed outside said boundary voxels.
2. The method of claim 1, wherein said second representation comprises a matrix of segments including a plurality of spaced apart parallel line segments, further comprising the step of compressing said plurality of line segments by eliminating inner voxels of said 3D object, said inner voxels disposed inside said boundary voxels.
3. The method of claim 2, wherein each of said plurality of line segments are represented as a pair of integer numbers corresponding to a z-coordinate of said boundary voxels for each non zero voxel of an x-y plane in said first representation, said segments having a length corresponding to a distance between said boundary voxels.
4. The method of claim 2, wherein said matrix of segments has the form  $Archive[x][y], 0 \leq x < W, 0 \leq y < H$ , where  $Archive[i][j] = Line_{ij}$ .
5. The method of claim 1, wherein said 3D object is an artificial object, further comprising the step of defining attributes of said 3D object using user defined external commands.

6. The method of claim 5, wherein said attributes comprise position, dimensions and color.

7. The method of claim 2, further comprising the step of displaying an image of said voxel object on a display device directly from said matrix of segments representation, wherein no buffer is used.

8. The method of claim 1, further comprising the step of storing said first and said second representation in computer memory.

9. The method of claim 7, further comprising the step of dynamically modifying an image displayed on said display device, wherein said modifying includes modification of said matrix of segments.

10. The method of claim 9, further comprising the step of writing said image to a buffer for storage as a stored frame.

11. The method of claim 10, wherein a plurality of said stored frames are combined over a specific timeframe to produce an animated film.

12. A machine readable storage having stored thereon a computer program for manipulating a voxel object, said computer program comprising a routine set of instructions for causing the machine to perform the steps of:

selecting a voxel grid comprising a plurality of voxels;

representing a 3D object in a first voxel space representation comprising at least a portion of said plurality of voxels, and

converting said first representation into a second voxel space representation, wherein said second representation is defined by boundary voxels representing a border of said 3D object, said second representation being exclusive of outer voxels, said outer voxels disposed outside said boundary voxels.

13. The machine readable storage of claim 12, wherein said second representation comprises a matrix of segments including a plurality of spaced apart parallel line segments, further comprising the step of compressing said plurality of line segments by eliminating inner voxels of said 3D object, said inner voxels disposed inside said boundary voxels.

14. The machine readable storage of claim 13, wherein each of said plurality of line segments are represented as a pair of integer numbers corresponding to a z-coordinate of said boundary voxels for each non zero pixel of an x-y plane in said first representation, said segments having a length corresponding to the distance between said boundary voxels.

15. The machine readable storage of claim 14, wherein said matrix of segments has the form  $Archive[x][y], 0 \leq x < W, 0 \leq y < H$ , where  $Archive[i][j] = Line_{ij}$ .

16. A system for manipulating a voxel object, comprising:  
structure for representing or receiving a 3D object in a first voxel space representation comprising at least a portion of a plurality of voxels included in a voxel grid; and  
structure for converting said first representation into a second voxel space representation, wherein said second representation is defined by boundary voxels representing a border of said 3D object, said second representation being exclusive of outer voxels, said outer voxels disposed outside said boundary voxels.

17. The system of claim 16, wherein said second representation comprises a matrix of segments including a plurality of spaced apart parallel line segments, each of said plurality of line segments being compressed having no inner voxels of said 3D object, said inner voxels disposed inside said boundary voxels.

18. The system of claim 17, wherein each of said plurality of line segments are represented as a pair of integer numbers corresponding to a z-coordinate of said boundary voxels for each non zero pixel of an x-y plane in said first representation, said segments having a length corresponding to the distance between said boundary voxels.

19. The system of claim 17, further comprising a user controlled voxel brush apparatus communicably connected to said system, said voxel brush for editing of said voxel object on a display device.

20. The system of claim 19, wherein said editing comprises simultaneously adding, deleting or changing a plurality of said voxels.

21. The system of claim 19, wherein said editing includes at least one of altering a color of selected ones of said voxels, translation of said voxel object, rotation of said voxel object, and altering a size or shape of said voxel object.

22. The system of claim 19, wherein said voxel object is directly rendered on said display device from said matrix of segments, wherein no buffer is used.

23. The system of claim 19, wherein said voxel brush provides at least one selected from the group consisting of structure for positioning said voxel object using a plane in 3D space, structure for positioning said voxel object using a 2D image of said 3D object, and structure for using at least one of cubic, spheric, elliptic, and random templates to represent said voxel object.